NATURAL RESOURCES CONSERVATION SERVICE
CONSERVATION PRACTICE STANDARD

TERRACE

(ft)
CODE 600

DEFINITION

An earth embankment, a channel, or a combination ridge and channel constructed across the slope.

PURPOSE

- Reduce slope length,
- Reduce erosion, and sediment content in runoff water,
- Improve water quality,
- Intercept and conduct surface runoff at a non-erosive velocity to a stable outlet,
- Retain runoff for moisture conservation,
- Prevent gully development,
- Reform the land surface and improve farm-ability, or
- Reduce flooding.

CONDITIONS WHERE PRACTICE APPLIES

This practice applies where:

- Water erosion is a problem,
- There is a need to conserve water,
- The soils and topography are such that terraces can be constructed and farmed with reasonable effort,
- A suitable outlet can be provided, or
- Runoff and sediment can damage land or improvements downstream or impair water quality.

This standard applies to the planning and design of all types of terraces. It does not apply to diversions.

CRITERIA

Spacing. The maximum spacing for terraces for erosion control shall be determined by the following method:

$$V.I. = xs + y \text{ or } H.I. = (xs+y)\ (100/s)$$

Where:

V.I. = vertical interval in ft

H.I. = horizontal interval in ft.

x = a constant, Use 0.7 in New Mexico

s = land slope in percent

y = a variable with values from 1.0 to 4.0

Soil erodibility, cropping system, and crop management practices influence values of "y". A value of 1.0 shall be selected for erodible soils with tillage systems that provide little or no cover during periods of intense rainfall. A value of 4.0 shall be used for erosion-resistant soils with tillage systems that leave a large amount of cover (e.g. 1.5 tons of straw per acre) on the surface. A value of 2.5 shall be used if one of the factors indicated is favorable and the other unfavorable. Other values between 1.0 and 4.0 may be used according to the estimated quality of the factors. The minimum horizontal spacing is 90 ft.

In no case shall the maximum horizontal spacing exceed that shown in **Table 1** for the conditions shown. The limits may not be exceeded when making the adjustments indicated below. Spacing may be increased as much as 10 percent to provide better alignment or location, to adjust for farm machinery, or to reach a satisfactory outlet. Spacing may be increased an additional 10 percent for terraces with underground outlets. The spacing shall be adjusted to provide for an even number of trips for anticipated row crop equipment and maximum opportunity for changing row widths. The likelihood of benching of steep slopes by tillage, land forming, and erosion shall be considered when determining the terrace interval.

For level terraces used for erosion control and water conservation, the spacing shall be determined as indicated earlier, but the maximum horizontal spacing shall not exceed 600 ft.

An "x" value of 0.7 may be used for all level terraces used primarily to impound water.

For terraces on non-cropland, the maximum spacing shall be governed by the capacity requirement.

Alignment. Terraces shall be parallel if feasible and as parallel as practicable. Curves shall be long

and gentle to accommodate farm machinery. Land forming, extra cut fill along the terrace line, multiple outlets, variations in grade, channel blocks, and other methods shall be used to achieve good alignment.

Field efficiency may be used to compare alternative terrace systems. Field efficiency is the ratio of time required to farm the field being planned, to that required to farm a rectangular field of the same acreage ½ mi. long.

Capacity. The terrace shall have enough capacity to control the runoff from a 10-year frequency, 24-hour storm without overtopping. For terraces with underground outlets, the capacity shall be increased by the estimated 10-year sediment accumulation, unless provisions are made to maintain the design capacity through maintenance. Terrace systems designed to provide flood protection or to function with other structures shall have adequate capacity to control a storm of a frequency consistent with the potential hazard. When the capacity is determined by the formula Q = AV and the V is calculated by using Manning's formula, an n value of 0.06 shall be used for bare channels; and SCS-TP-61, Handbook of Channel Design for Soil and Water Conservation, or equivalent, shall be used for vegetated channels.

Cross-section. The terrace cross section shall be proportioned to fit the land slope, the crops grown, and the farm machinery used. Additional height shall be added if necessary to provide for settlement, channel sediment deposits, ridge erosion, the effect of normal tillage operations, and safety. The ridge shall have a minimum width of 3 ft. at the design elevation. The minimum slope of a vegetated front or back ridge slope is 2:1. The opening at the outlet end of gradient and open-end level terraces shall have a cross section equal to that specified for the terrace channel.

End closures. Level terraces may have open ends; partial end closures, or complete end closures. Partial and complete end closures shall be used only on soils and slopes where the stored water will be absorbed by the soil without appreciable crop damage or where underground outlets are provided.

If terraces with closed or partly closed ends are specified, the end closures must be installed before the terraces are completed. The end closures shall be designed so that the water flows over the end closure before overtopping the terrace ridge.

Partial end closures shall not be more than half the effective height of the terrace ridge. Complete end closures are more than half the height of the ridge. The cross section of the closures may be less than the terrace cross section.

Channel grade. Channel grade shall be determined by one of the following methods:

- Maximum channel grade in the lower reaches of the channel shall not exceed 0.6 percent,
- Maximum channel velocity for farmed channels shall be non-erosive for the soil and planned treatment. Maximum velocity for erosion-resistant soils is 2.5 ft/s; for average soils, 2.0 ft/s; and for easily erodible soils, 1.5 ft/s. Velocity shall be computed by Manning's formula, using an n value of 0.035.
- Maximum channel velocities for permanently vegetated channels shall not exceed those used for grassed waterways.

Channel grades may be uniform or variable. Channel velocity shall not exceed that which is non-erosive for the soil and planned treatment. For short distances and in upper reaches, channel grades or velocities may be increased to improve alignment. If terraces have an underground outlet, water and sediment will pond in the channel, thus reducing the velocity and allowing steeper channel grades near the outlet. Minimum grades shall be such that

Table 1

Maximum horizontal spacing for terraces

Slope	RUSLE 1 R factor of 0 - 35		35 - 175		More than 175		With contour Strip cropping		For concentrated flow control	
Percent	ft	m	ft	m	ft	m	ft	m	ft	m
0 - 2	700	210	500	150	450	130	600	180	700	210
2 - 4	700	210	400	120	300	90	600	180	700	210
4 - 6	600	180	400	120	200	60	600	180	600	180
6 - 9	400	120	300	90	150	45	400	120	500	150
9 - 16	400	120	250	75	150	45	250	75	500	150
12 - 18	250	75	200	60	150	45	150	45	400	120
More than 18	250	75	200	60	150	45	150	45	300	90
Minimum spacing										
All slopes	200	60	150	45	90	27	90	27	200	60

ponding in the channel because of minor irregularities will not cause serious damage to crops or delay field operations.

Terrace length. The volume of water stored in level terraces is proportional to the length. Therefore, it is necessary that the length be held within reason so that damage in case of a break is minimized. Level terrace length shall not exceed 3,500 ft unless the channel is blocked at intervals not exceeding 3,500 ft. Normally, the capacity and the non-erosive velocity requirements control the gradient terrace length.

Outlets. All terraces must have adequate outlets.

Vegetated outlets may be used for gradient or open-end level terraces. Such an outlet may be a grassed waterway or a vegetated area. The outlet must convey runoff water to a point where the outflow will not cause damage. Outlets shall be installed and vegetated before the terrace is constructed if necessary to provide a stable non-erodible outlet or to insure establishment of vegetative cover. The water surface in the terrace shall not be lower than the water surface in the outlet at their junction when both are operating at design flow.

Underground outlets may be used on gradient or level terraces. The outlet consists of an intake and an underground conduit. An orifice plate, increase in conduit size, or other features shall be installed as needed to control the release rate and prevent excessive pressure when more than one terrace discharges into the same conduit. The discharge, when combined with the storage, shall be such that a 10-year frequency, 24-hour storm will not overtop the terrace, and growing crops will not be damaged significantly by standing water. The release time shall not exceed 48 hours for the design storm. Shorter periods may be necessary for some crops, depending on soils characteristics and water tolerance of crops to be grown.

The underground conduit shall meet the requirements specified in NRCS Standards 620, Underground Outlets, or 606, Subsurface Drains. Conduits must be installed deep enough to prevent damage from tillage equipment. The inlet shall consist of a vertical perforated pipe of a material suitable for the intended purpose. The inlet shall be

located uphill of the front slope of the terrace ridge, if farmed, to permit passage of farm machinery and, if necessary, provide for the anticipated accumulation of sediment and subsequent raising of the terrace ridge. The outlet of the conduit shall have adequate capacity for the design flow without causing erosion.

Soil infiltration may be used as the outlet for level terraces. Soil infiltration must permit drainage of the design storm from the terrace channel within a reasonable period so standing water does not significantly damage crops.

Combinations of different types of outlets may be used to maximize water conservation and to provide for economical installation of a more farmable system.

Vegetation. All areas to be vegetated shall be established to grass as soon as practicable after construction. The sod shall be maintained and trees and brush controlled by chemical or mechanical means.

CONSIDERATIONS

Effects on the water budget, especially on volumes and rates of runoff, infiltration, evaporation, transpiration, deep percolation, and ground water recharge.

Variability effects caused by seasonal or climatic changes.

Effects of snow catch and melt on water budget components.

Potential for a change in plant growth and transpiration because of changes in the volume of soil water.

Effects on the downstream or aquifers that could affect other water uses and users.

The effect on the water table of the field to ensure that it will provide a suitable rooting depth, field wide, for anticipated land uses.

Potential for water management to supply alternate uses.

Effects on erosion and the movement of sediment, pathogens, and soluble and sediment-attached substances that would be carried by runoff on surface and ground water quality.

Effects on the visual quality of onsite and downstream water.

Short-term and construction-related effects on the quality of onsite and downstream water.

Potential for development of saline seeps or other salinity problems resulting from increased infiltration in soils that have restrictive layers.

Potential for uncovering or redistributing toxic materials such as saline soils.

Effects on the movement of dissolved substances below the root zone and to the ground water.

Effects on wetlands and water related wildlife habitats.

PLANS AND SPECIFICATIONS

Plans and specifications for installing terraces shall be in keeping with this standard and shall describe the requirements for applying the practice to achieve its intended purpose.

CONSTRUCTION

All dead furrows, ditches, or gullies shall be filled before constructing the terrace or shall be part of the construction. All old, terraces, fence rows, hedge rows, trees, and other obstructions shall be removed, as necessary, to install a farmable system.

The terraces shall be constructed according to planned alignment, grade and cross section with the specified overfill for settlement and the channel graded to drain reasonably well.

Any ditch or depression at the bottom of the back slope shall be filled and smoothed so that drainage will be away from the terrace and not parallel to it.

Provisions must be made to prevent piping if under ground conduits are located under terrace ridges. Mechanical compaction, water packing, trench sidewall sloping, and installation and backfill of conduit trenches early enough to allow adequate settlement are methods that can be used. The materials used for the inlet and the conduit shall be suitable for the purpose intended (See NRCS Standard 606, Subsurface Drains.).

Terrace ridges constructed across gullies or depressions shall be compacted by machinery travel or by other suitable means to insure proper compaction and functioning of the terrace.

The surface of the finished terrace shall be reasonably smooth and present a workmanlike finish.

If necessary, topsoil shall be stockpiled and spread over excavations and other areas to facilitate restoration of productivity.

If vegetation is required, seedbed preparation, fertilizing, seeding, and mulching shall comply with the NRCS FOTG, Section IV.

OPERATION AND MAINTENANCE

A program shall be established for maintaining terrace capacity, storage, ridge height, and outlets. Each inlet for underground outlets must be kept clean and sediment buildup redistributed so that the inlet is able to drain all water. Inlets damaged or cut off by farm machinery must be replaced or repaired immediately.

Terrace ridges, especially those with steep back slopes, can be very hazardous. For this reason, some farmers prefer steep front slopes, thus keeping machinery away from the steep back slopes. All cut and fill slopes that are to be farmed must be no steeper than those on which farm equipment can operated safely.

REFERENCES

NRCS Field Office Technical Guide